

Problems: Electronics Calculation – Mine warfare

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Background:

Electronics technicians who perform operations and maintenance for mine warfare systems on board ships must sometimes solve mathematical problems. Following are two situations in which they are required to work with formulas.

A dipole antenna is an antenna that will resonate on a specific operating frequency. When the antenna is resonant, it has better sending and receiving properties. Technicians use a formula to calculate how long the wire in the antenna should be to optimize for the frequency that's being used.

Technicians also use a formula for radar, which is used to figure out the range of a target on the radar display. The radar signal propagates at the speed of light and the time to travel to the object being detected, then reflect off of it must be calculated. This can be expressed as a constant in microseconds [and can be used for determining ranges in nautical miles. This answers the question: how far away is the object being detected?

You are an electronics technician on a ship involved in mine warfare.

Problem A:

Use the formula for a wave dipole antenna using 14-gauge wire

$$\text{length}_{\text{ft}} = \frac{468 \text{ ft}}{\text{fMHz}}$$

to calculate the length in feet for the frequency 1.7 GHz

fMHz = frequency in megahertz

1 GHz = 1,000 MHz

1 ft = 12 inches

GHz = gigahertz

Hertz is cycles per second.

Problem B:

Use the formula for Radar range (Nautical miles) = Elapsed time/12.36 mS

Microsecond = 1 millionth of 1 second

mS = microseconds

If the elapsed time for the return pulse (echo) is 61.8 mS, what is the range of the target?

Solutions: Electronics Technician

Problem A

$$\text{length}_{\text{ft}} = \frac{468 \text{ ft}}{\text{fMHz}}$$

$$1.7 \text{ GHz} = \left(\frac{1000 \text{ MHz}}{1 \text{ GHz}} \right) = 1700 \text{ MHz}$$

$$\text{length}_{\text{ft}} = \frac{468 \text{ ft}}{1700}$$

$$\text{length}_{\text{ft}} = 0.275 \text{ ft} = 3.30 \text{ inches}$$

Answer: 3.30 inches

Problem B

$$\text{Range}_{\text{n mi}} = \frac{\text{Elapsed time (mS)}}{12.36 \frac{\text{mS}}{\text{n mi}}}$$

$$\text{Range} = \frac{61.8 \text{ mS}}{12.36 \frac{\text{mS}}{\text{n mi}}}$$

$$\text{Range} = 5.00 \text{ n mi}$$

Answer: 5 nautical miles